REMARKS

By the present amendment, claims 1 to 9 are pending in the application.

§112, ¶2

Claims 1 to 9 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite.

In response to this rejection, the claims have been amended by the present amendment.

The claims have been amended by deleting the term "fewer".

In claims 1 and 2, the phrases "consisting mainly of" and "consisting principally of " have been changed to read --consisting essentially of--.

In view of the present amendment, it is respectfully requested that the rejection of claims 1 to 9 under 35 U.S.C. §112, second paragraph, be withdrawn.

§103

Claims 1 to 3 and 8 to 9 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,120,578 to Nakato.

Claims 4 to 7 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No.6,120,578 to Nakato et al. in view of EP 0 906 960 to Nabeshima et al.

These rejections are respectfully traversed.

The Present Invention

The present invention relates to a steel prepared by casting liquid steel deoxidized with Al, including one or more rare-earth metals (REMs) selected from the group of Ce, La, Pr and Nd, and is characterized by, containing alumina clusters in which oxide-based inclusions consisting essentially of alumina and REM-oxide contain REM-oxide of not less than 0.5 mass% and not more than 15 mass%.

Patentability

Comparison of claim 1 of the present invention and USP 6,120,578 ('578 patent).

The Office Action takes the position that the '578 patent discloses:

1) method for producing an Al-killed steel without containing clusters,

2) controlling alumina in the range of 30 - 85 wt% in inclusions,

3) controlling REM in the range of 0.5 - 15 wt%,

(Applicants do not understand the Office Action's comment "this allows one to include REM-oxides in the range of 0.5 - 15 mass% along with other minor oxides such as MgO and CaO".)

4) The amount of REM-oxides is important in controlling the shape of the oxide and subsequent formation of clusters,

5) The ratio of REM to Al should be controlled to regulate the oxides formed and allow for separation.

In column 3, lines 22 - 27 of US '578, there is a disclosure that "When the value of REM/Al exceeds 0.1, individual sulfides and oxides of REM are apt to be produced owing to strong deoxidation and desulfurization abilities of the REM. Such sulfide and oxide of REM have high specific gravity, so that it is difficult to separate and remove them from molten steel".

The Office Action concludes that one with ordinary skill could then optimize the cluster composition and thus the REM-oxide mass percentage to achieve the claimed range.

However, although a prevention of alumina cluster formation as a problem to be solved by the present invention is a common technical problem between the present

invention and the '578 patent, a means of solving the problem and the cluster composition are quite different.

As defined in claim 1 of the present invention, deoxidation is carried out using Al, and then adding one or more rare-earth metals (REMs) selected from the group of Ce, La, Pr and Nd to the molten steel. That is, the alloying elements to be added to the molten steel after Al deoxidation is only selected from REMs. On the other hand, the '578 patent discloses, in column 2, lines 6 - 13, to charge an alloy consisting of Al and two or more elements selected from Ca, Mg and REM into the molten steel to conduct deoxidation, and to adjust Al203 in the resulting inclusion to a range of 30 - 85%. This is a main feature of the '578 patent. The '578 patent further discloses, in column 2, lines 46 - 53, that the reason why the deoxidizing agent is the alloy of Al and two or more of Ca, Mg and REM is due to the fact that when the alloy is Al and one of Ca, Mg and REM, the formation of composite inclusion and the shape control thereof become unstable, and the effect of preventing the formation of aluminum clusters is insufficient, and hence the effect of satisfactorily improving the surface quality in the thin steel sheet cannot be achieved. Therefore, in the '578 patent, the deoxidizing agent which is the alloy of Al and two or more of Ca, Mg and REM is an indispensable feature. The '578 patent excludes only one deoxidizing agent, such as REM only.

In contrast, the present invention does not require two or more of Ca, Mg and REM as the deoxidizing agent. The present invention only use Al with REM oxide as a constitution of inclusion as defined in the claims, and there are no examples in the present specification an oxide composed of Ca or Mg.

The present invention further defines to control the REM-oxide-content in the oxide-based inclusions consisting essentially of alumina and REM-oxides to 0.5 - 15 mass%

because when the REM-oxide-content is controlled within this range, agglomeration and coalescence of alumina particles can be inhibited and formation of coarse alumina clusters prevented. However, in the '578 patent, there is no disclosure or suggestion about this feature of the present invention.

The technical features defined in claim 1 of the present invention are not disclosed or suggested by the '578 patent.

It is therefore submitted that claim 1, and all claims dependent thereon, are patentable over the '578 patent.

Comparison of claim 2 of the present invention and the '578 patent.

The '578 patent discloses at Col. 3, lines 56 to 63 that a preliminary deoxidation is carried out to control the free oxygen contained in the molten steel to a concentration amount of not more than 200 wtppm before adding the alloying elements in order to reduce the alloying elements content from the economical view point.

On the other hand, claim 2 of the present invention defines that the mass ratio of total REM to total oxygen (T.O.), i.e., REM/T.O., is not less than 0.05 and not more than 0.5 for preventing the formation of alumina clusters by means of addition of alloying elements selected from REMs to a deoxidized molten steel by Al, and the amount of REM oxide contained in the oxide inclusions. This is not to reduce the amount of alloying elements. Therefore, this feature of the present invention is not disclosed or suggested by the '578 patent.

Therefore, claim 2, and all claims dependent thereon, are patentable over the '578 patent.

Comparison of claim 3 of the present invention and the '578 patent.

The Office Action takes the position that the total REM concentration and dissolved REM concentration defined in the present invention are substantially equal to the

REM concentration of 0.4 ppm and total oxygen amount of 18 ppm in Example 3 of the '578 patent. However, the calculated value of the total oxygen content in the '578 patent is 40 ppm (Example 1), 42 ppm (Example 2) and 40 ppm (Example 3). These values are quite different from claim 3 of the present invention.

It is therefore submitted that claim 3, and all claims dependent thereon, are patentable over the '578 patent.

Comparison of claims 4 - 7 of the present invention and the '578 patent and EP 0 906 960 ('960 patent).

The Office Action takes the position that the subject matter of claims 4 - 7 are not disclosed in the '578 patent. However, a person skilled in the art can easily conceive the subject matter of claims 4 - 7 by combining the '578 patent and the '960 patent because the '960 patent discloses certain molten steel compositions. It is submitted that this understanding is incorrect.

Molten steel compositions disclosed in the '960 patent are deoxidized by Ti, as shown in Table 1, as indispensable feature, which is a quite different deoxidation by means of Al according to the present invention.

Regarding inclusion formation, the compositional ranges targeted by the '960 patent contain Ti oxide as shown in Fig. 2 of the '960 patent. According to the '960 patent, the ranges of alumina: 82.4 - 98.5 wt% and REM oxide concentration: 0.5 - 15 wt%, of the present invention, would cause nozzle clogging as shown in attached Fig. A which is based on Fig. 2 of the '960 patent. Therefore, the composition of the formed inclusions disclosed in the '960 patent is quite different from those of the present invention. Accordingly, the subject matter of claims 4 to 7 of the present invention cannot be conceived of from a combination of the teachings of the '578 patent and the '960 patent.

It is therefore submitted that claims 4 to 7 are patentable over the '578 patent in view of the '860 patent.

CONCLUSION

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that application, as amended, be allowed and passed for issue.

Respectfully submitted,

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